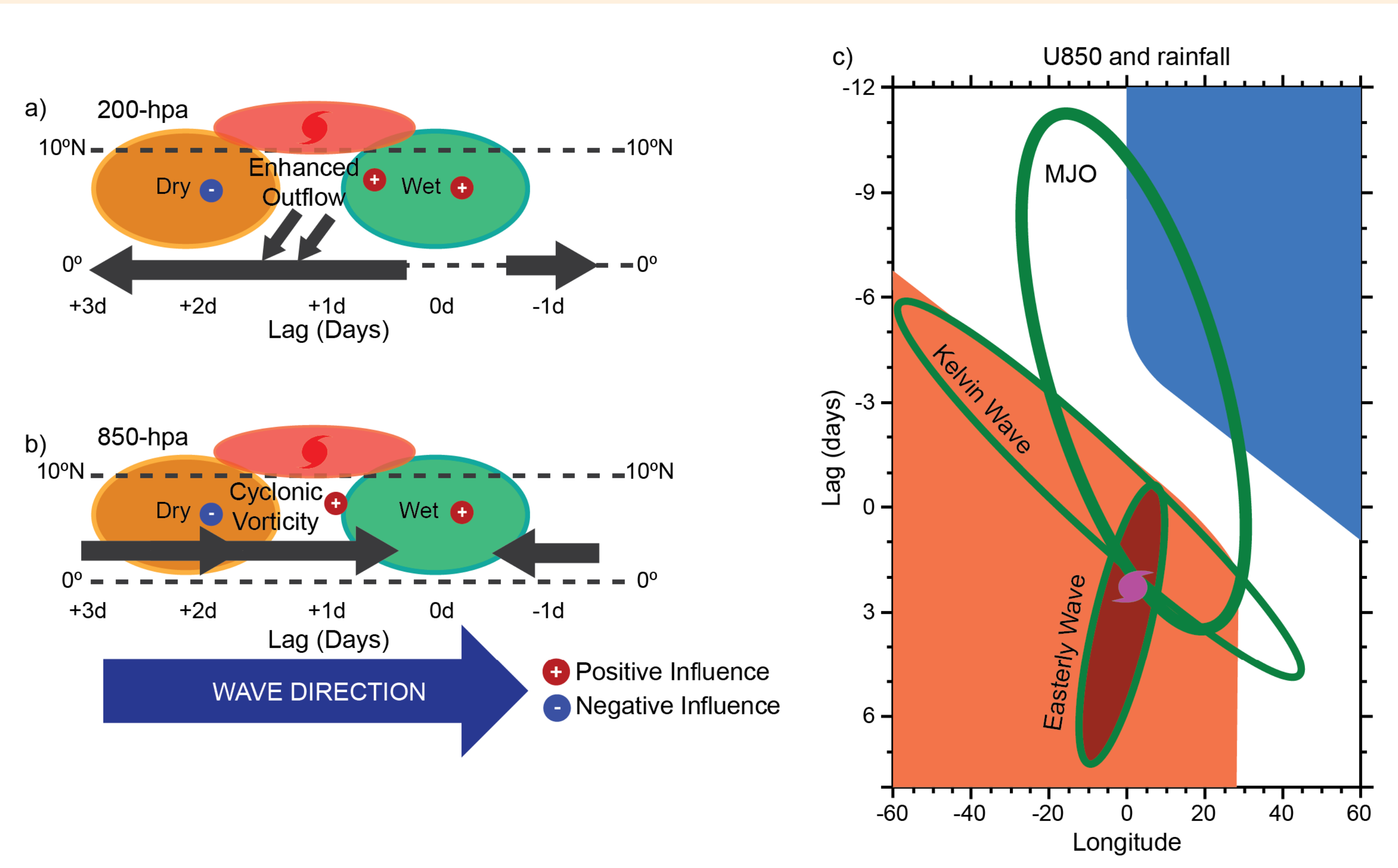


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Inspire. Advance. Engage.

Kelvin Waves and Tropical Cyclones



Schematic of Kelvin Wave composites from all basins. Adapted from:
Schreck, C. J., 2015: Kelvin waves and tropical cyclogenesis: A global survey. *Mon. Wea. Rev.*, In Press, doi:10.1175/MWR-D-15-0111.

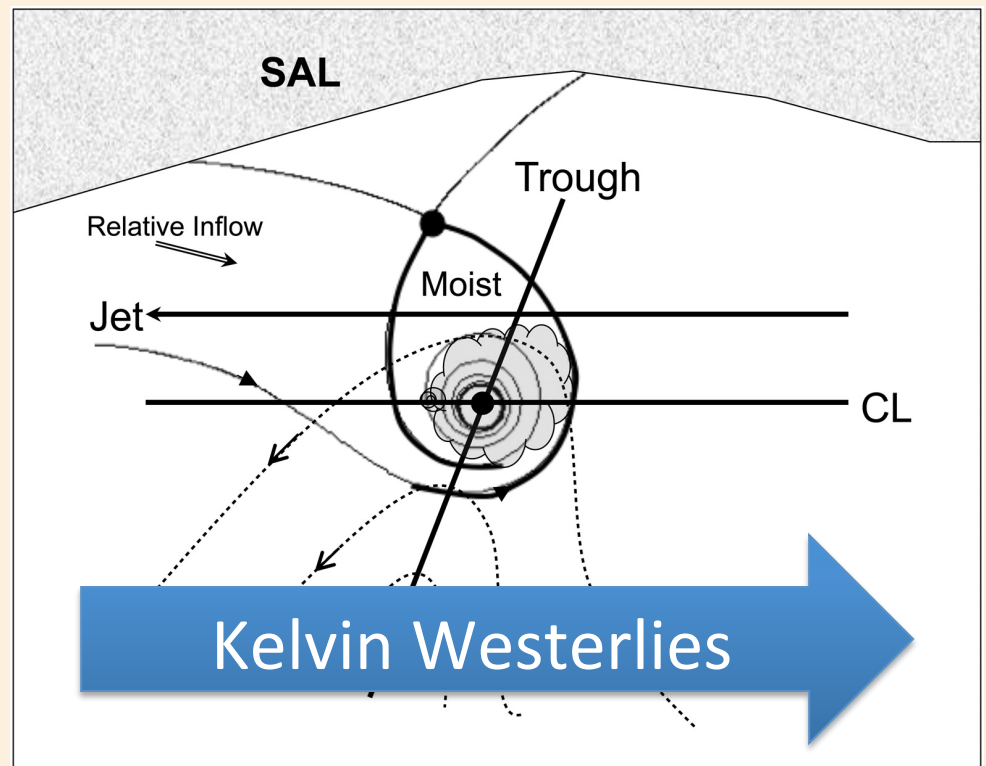
- **Convectively coupled Kelvin waves**
 - Eastward propagation at $10\text{--}20\text{ m s}^{-1}$
 - 3–10 day period, 2000–4000 km wavelength
- **Kelvin Waves modulate key factors for cyclogenesis**
 - Low-level vorticity, convection, vertical wind shear
 - But net impact on tropical cyclone activity is uncertain
- **Tropical cyclones inhibited for 3 days before Kelvin wave passage and enhanced 3 days after**
- **Circulation seems to be the dominant factor**
 - Low-level vorticity
 - Upper-level outflow
- **Kelvin waves frequently interact with the MJO and easterly waves during genesis**

Hypothesis

Equatorial westerlies from Kelvin waves help close the pouch's circulation

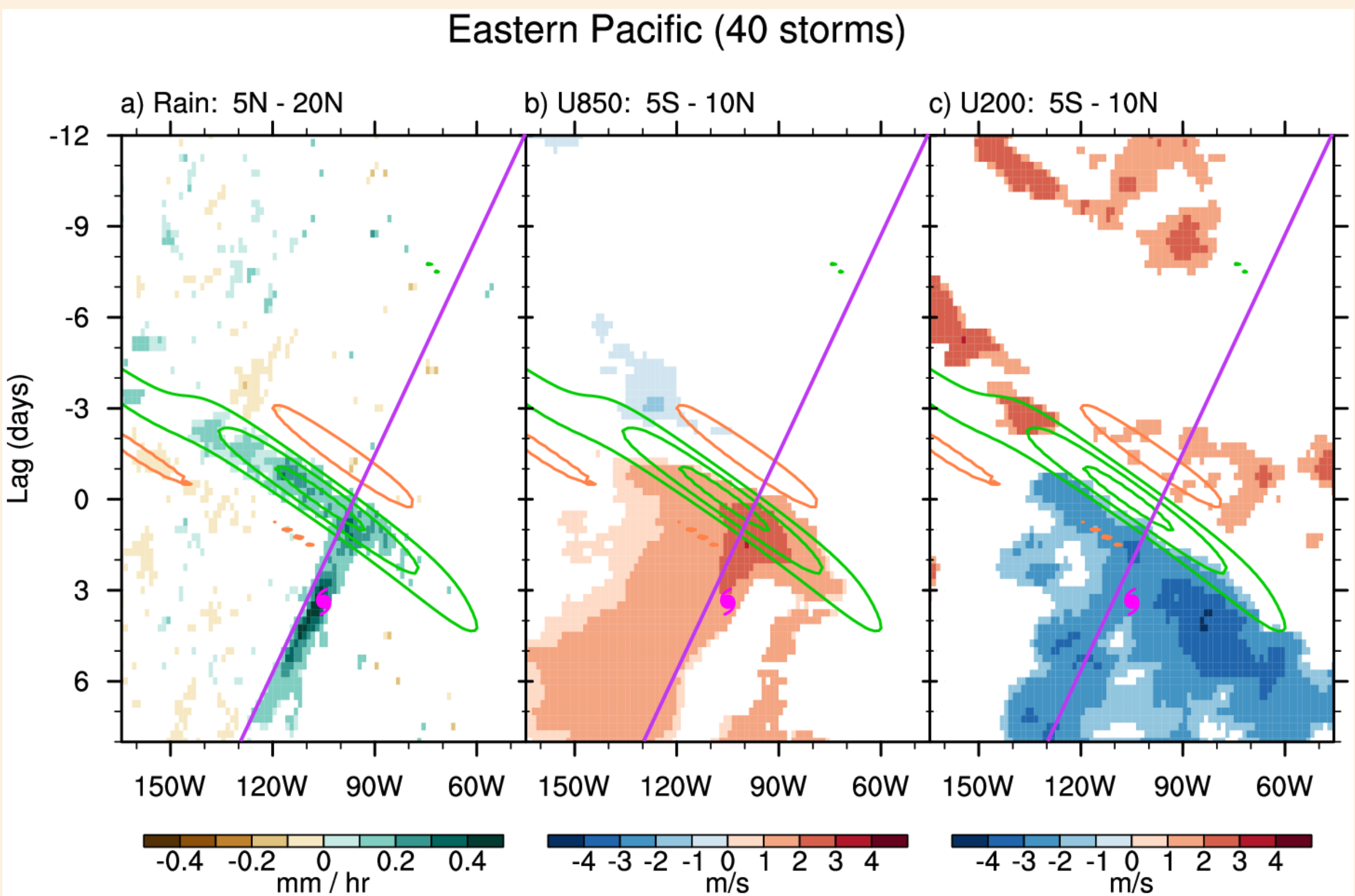
- Kelvin waves are tilted westward with height
- Cyclogenesis occurs when the Kelvin wave westerly anomalies reach mid-levels (600 hPa)
- This tilt may explain the 0–3 day lag between Kelvin wave passage and genesis.

Still investigating other levels and basins



Schematic of an easterly wave's pouch. Adapted from Wang et al. 2010).

Pouch Phase Speed

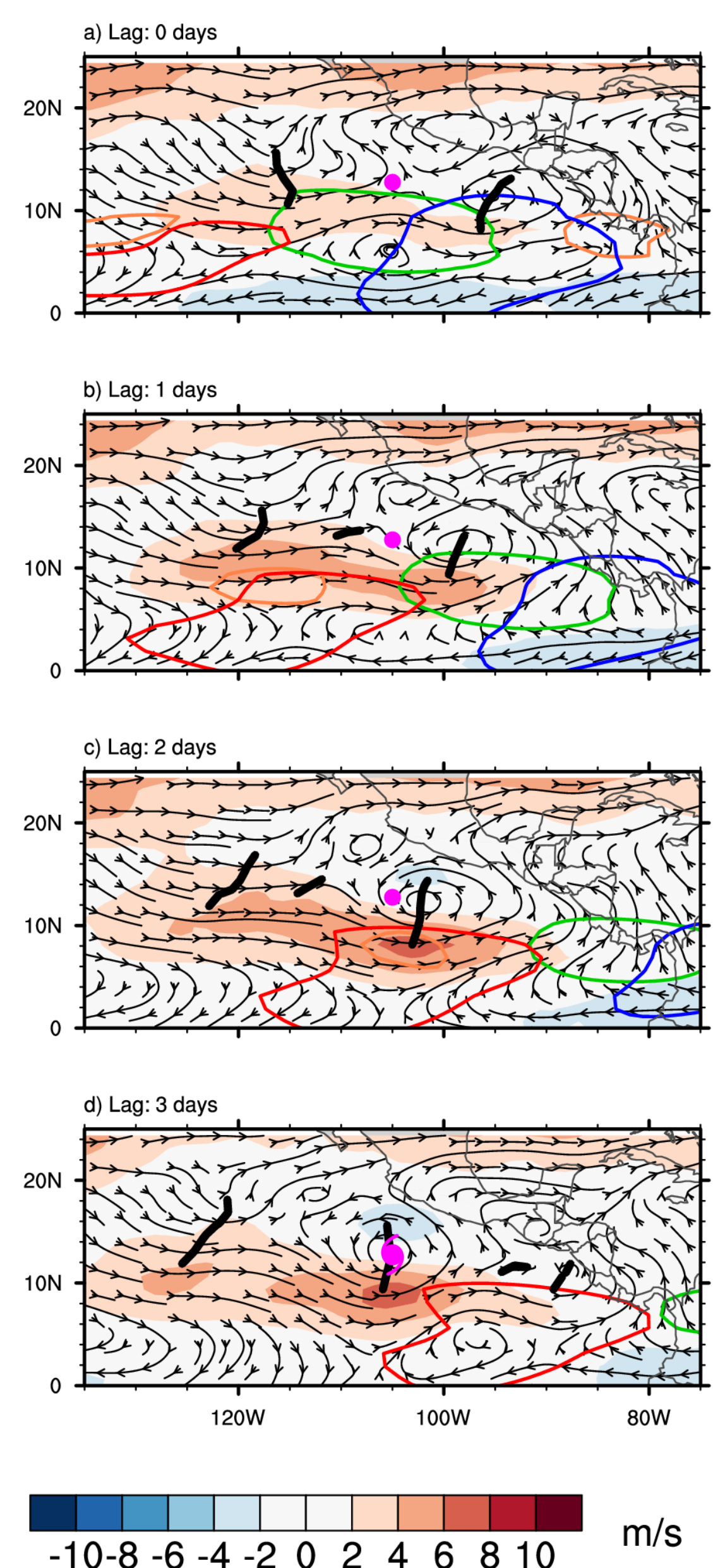


Composite Hovmöllers of (a) Rainfall, (b) 850-hPa zonal wind, and (c) 200-hPa zonal wind anomalies for tropical cyclones that formed 3.5 days after Kelvin wave passage. Magenta lines denote the estimated phase speed of 5 m s^{-1} .

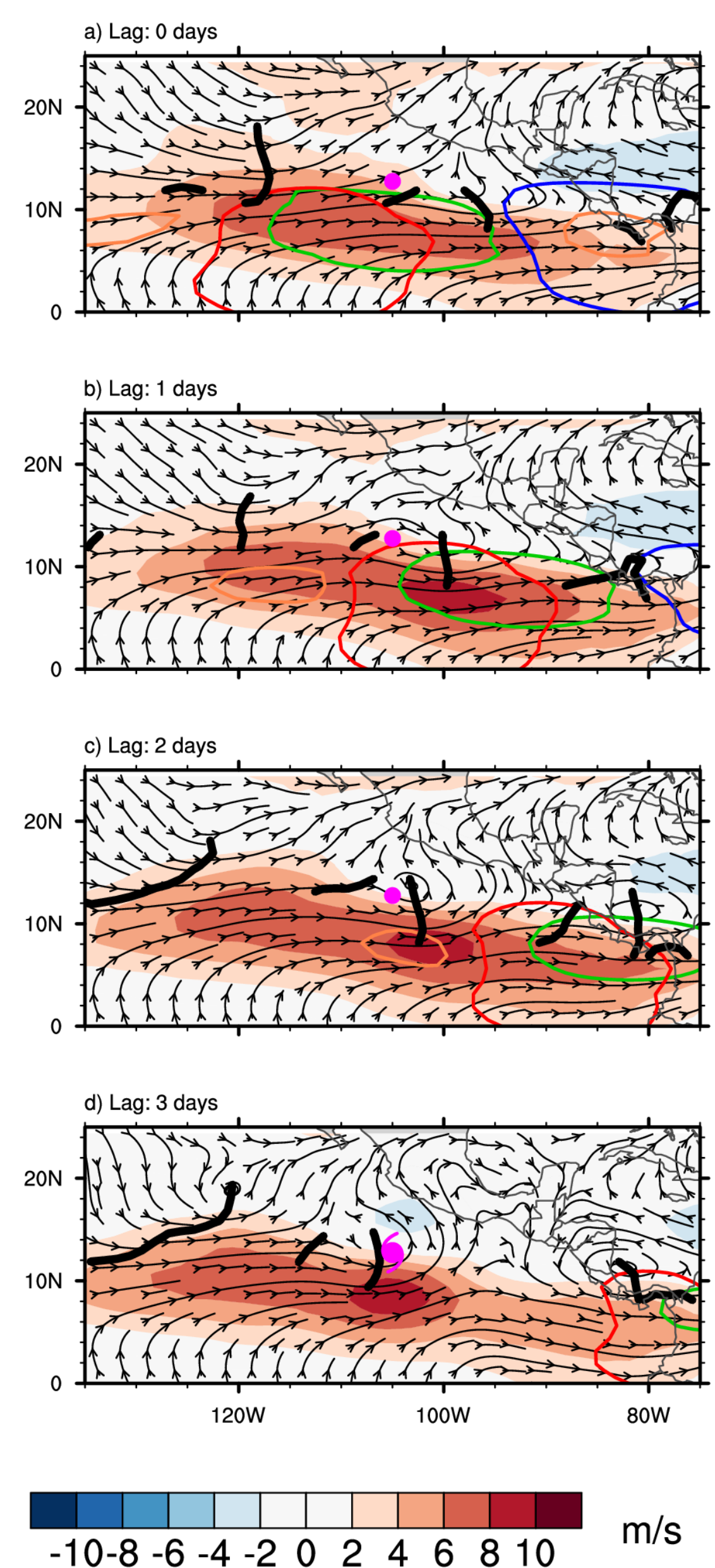
- **Easterly wave phase speed is estimated from composite Hovmöllers of tropical cyclogenesis with Kelvin waves**
- **This phase speed is subtracted from the composite zonal winds to produce Lagrangian streamlines**

Pouch Composites

EP_genesis_3_-5.1_u600 (40 storms)



EP_genesis_3_-5.1_u850 (40 storms)



Composite maps of easterly wave-relative zonal winds at 850-hPa (left) and 600-hPa (right). Lags are relative to Kelvin wave passage. Tropical cyclogenesis happens at lag +3.5 days. Black lines identify trough axes (meridional wind = 0, cyclonic relative vorticity). Green and orange contours identify wet and dry envelopes of the Kelvin waves, respectively. Similarly the red and blue are the westerly and easterly phases.

- **850 hPa (left)**
 - Kelvin wave enhances the westerly anomalies at lag +1 day
 - Genesis occurs 2.5 days later when the Kelvin wave westerlies are farther east
- **600 hPa (right)**
 - Kelvin wave enhances the westerly anomalies at lag 2–3 days
 - Genesis occurs shortly after this enhancement of the closed circulation